

FLAGON PVC ROOFING



YOUR ROOFING AND WATERPROOFING PARTNER

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PVC ROOF SYSTEMS



INTRODUCTION

This section of the technical manual includes sectional diagrams, construction details and laying instructions for waterproofing with FLAGON PVC membranes. Careful design and correct laying are the prerequisites for a long, functional life of the waterproof package. For optimal waterproof performance, carefully read this technical manual, the product data sheets and the information contained on the website www.flag.it or on the Flag CD-ROM attached to the documents. Drawings and technical details can be downloaded from the site in Autocad format. Due to space limitations, the details and the drawings reproduced in the following pages are only a few examples of those that can be found on the website or CD-ROM. Flag engineers will be happy to develop specific technical solutions not included in our documentation.

FLAGON PVC MEMBRANES

PVC membranes appeared on the waterproof systems market in the late 60's, their technical characteristics affording them an ever growing share of the roofing market. These materials have proved suitable for use on any substrates, especially those with marked structural movements, i.e. metal parts or prefabricated concrete slab. For roof operations, the FLAGON PVC range offers various materials; for example, waterproof membranes with non-woven glass mesh reinforcement (ballasted and adhered roof systems), possibly combined with geotextile, with reinforced polyester mesh (mechanically fastened exposed roof systems) or un-reinforced homogeneous membranes (ballasted roof systems for vehicular traffic or roof garden).

MAIN CHARACTERISTICS

The main characteristics of all FLAGON PVC membranes are:

- Flexibility in low temperatures
- Insensitivity to hot-cold cycles
- High mechanical resistance.
- Resistance to static and dynamic puncturing
- Vapour permeability
- Adaptability to structural movements
- Resistance to root growth and micro-organisms.
- Do not rot.
- Resistance to weathering and ultraviolet rays.
- The surface colours may be chosen from the RAL range

In addition to these technical features, the various types of reinforced membranes have other properties outlined below:

- Glass mesh reinforced membranes > Dimensional stability.
 - Polyester mesh-reinforced membranes > Resistance to tear under wind stress
- FLAGON PVC membranes are manufactured in UNI EN ISO 9001 certified plants and fully comply with the performance standards CEN European Standard, UNI 8629/6 – SIA 280 – DIN 16726.

MANUFACTURING PROCESS

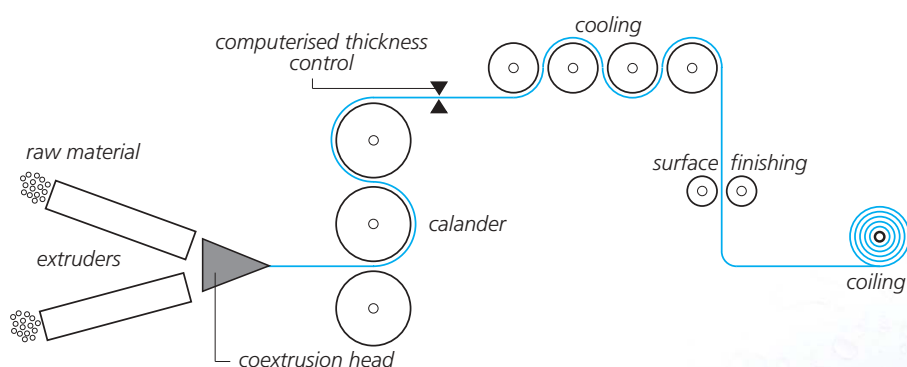
Manufacturing processes for this wide range of materials are quite diversified, and specifically include:

COEXTRUSION

In this process, the mixture of material components (resins, plasticisers, stabilisers, pigments, etc.) in each extruder is introduced through a hopper into a cylindrical chamber.

Here it is heated up and pressed by worm screws into a co-extrusion head, where the single extruders converge, and then it is laminated in a calender. The liner thickness is automatically adjusted by electronic equipment that controls the opening of the extrusion head and of the calender.

The material thus obtained is a single-layer homogeneous, non-reinforced liner, with high tensile properties and high resistance to static and dynamic puncturing. This process can also produce two-colour, single-layer membrane with a signal layer.



NOTE: This diagram merely gives an idea of the process and is not indicative of the actual lay-out and methods used at the FLAG S.p.A.'s proprietary plant.



CASTE SPREADING

This is a manufacturing process that creates waterproof membranes in which the reinforcement becomes an integral part of the liner.

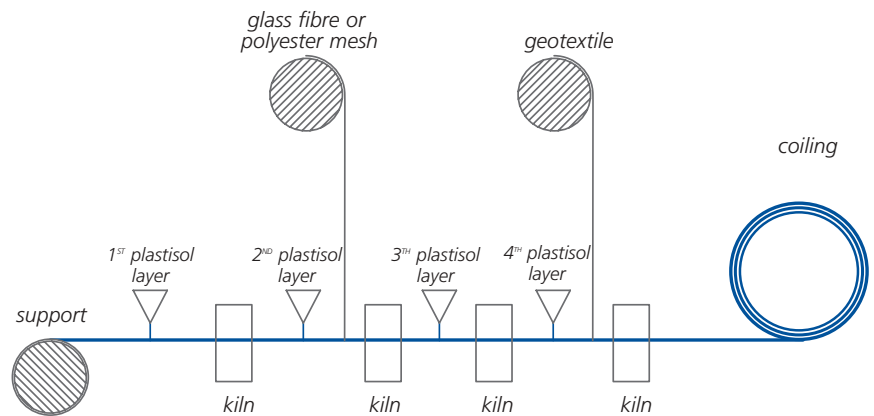
At room temperature, a spreading head lays a substrate of a mixture of liquid-viscous state products called "plastisol". This contains resins, plasticisers, stabilisers, pigments, etc. and determines the final characteristics of the waterproof liner.

After gelation (a melting process), achieved by raising the temperature inside the ovens, the plastisol solidifies.

The spreading and gelation process is repeated on line four times in a row.

Thus, membranes manufactured by the spreading method are composed of four differently formulated layers. An internal reinforcement, either polyester or glass mesh, is inserted between the second and third layers.

This manufacturing system establishes a molecular bond between the four layers creating a homogenous and flexible single-layer liner that can be combined with a thermally treated geotextile layer that improves its gripping characteristics or allows it to be laid on materials that are not chemically compatible with PVC-P. The spreading process can also produce two-colour, single-layer membranes with a signal layer.



NOTE: This diagram merely gives an idea of the process and is not indicative of the actual lay-out and methods used at the FLAG S.p.A.'s proprietary plant.

SELECTING THE SEALING ELEMENT

All FLAGON PVC roof membranes are formulated and manufactured to meet specific requirements. To simplify the selection of Flagon PVC products, please refer to the table below:

	FLAGON SV	FLAGON SP	FLAGON SFC	FLAGON SFB	FLAGON SR	FLAGON SRF	FLAGON A	FLAGON BT
Ballasted roof system not subject to pedestrian traffic	■							
Ballasted roof system subject to pedestrian/vehicular traffic		■					■	
Ballasted roof system for roof garden		■						■
Mechanically fixed roof system				■				
Mechanically fixed roof system on thermal insulation					■			
Fully adhered system on thermal insulation			■					
Fully adhered system on reinforced concrete			■					
Fully adhered system- renovation bituminous waterproofing				■				
Fully adhered system with exposed bituminous coating				■				
Exposed vertical surfaces	■		■					

ELEMENTS AND FUNCTIONAL LAYERS OF THE ROOF

An overview of the characteristics and specific functions of the “layers” of the various types of roof is useful to clarify the terms used, define the technical requirements of the materials and to better illustrate the examples given in the following pages.

1 - SUPPORTING ELEMENT OR SUBSTRATE (with or without falls)

This is the structural surface of the works to be waterproofed, onto which the most appropriate combination of sectional layers is applied. The structural element may be constructed using a variety of techniques, such as: traditional reinforced concrete or brick and cement floor, pre-cast concrete, corrugated sheet metal, etc. The surface of the structural element must be smooth and free from debris or irregularities that may puncture the waterproof stratification layers.



2 - ADJUSTMENT LAYER – COMPENSATION



The purpose of this layer is to take up any surface irregularities of the substrate, in order to avoid any imperfections or foreign particles damaging the vapour barrier or waterproof layers.

It can be made up of one of the following materials:

- Flag geotextile, a non-woven felt, minimum weight 500 g/m², laid in dry conditions with edge overlap of 10/15 cm;
- ISOLFLAG rigid polystyrene panels (or equivalent compensation layer), 10/20 mm thick with a density ranging between 15 and 25 kg/m³, laid in dry conditions, flush with membrane edges.

3 - VAPOUR SHIELD OR BARRIER LAYER



The purpose of this layer is to prevent any moisture working its way up from underlying structures and finding its way into the insulating layer, thus avoiding condensation within the roof covering. It is essential to incorporate a vapour retarder or barrier below the insulation when it is known that particular combinations of temperature and humidity may occur. The location of the dew point fall in temperature will decide whether or not a retarder or barrier is necessary. A vapour retarder may consist of:

- A layer of VAPORFLAG polyethylene film, 0.30 to 0.40 mm thick, dry-laid with 10 cm edge overlap and secured using double-sided adhesive tape;
- Bituminous polymer membrane laid in hot bitumen, with 5 cm edge overlap, welded by flame tempering.

4 - INSULATION LAYER



The purpose of this layer is to bring the thermal resistance of the roof system to a specified value, limiting heat loss to the extent required by insulation and energy conservation regulations and ensuring that temperature and humidity levels are maintained in the premises underlying the roof covering. The insulating layer must consist of rigid, high-density material to allow an adequate substrate for gluing or mechanical fixing. It is normally composed of expanded or extruded polystyrene, polyurethane, rock wool, etc. The insulation boards should provide the necessary density and rigidity to support the roof design and loadings

5 - SEPARATING LAYER



The function of this layer is to physically separate two adjacent, chemically incompatible elements of the waterproof package. The separating layer is normally made of Flag geotextile in non-woven felt, with minimum weight of 200 g/m².

6 - WATERPROOF MEMBRANE

The purpose of the waterproof membrane is to ensure complete and durable waterproofing of the roof area.

In the context of this waterproof system we shall consider the various FLAGON PVC synthetic membranes.

Each FLAGON PVC covering is characterised by an identification code. In the sectional diagrams given, only the FLAGON PVC membranes that correspond to the requirements of the waterproof project are indicated.



7 - FILTRATION LAYER

The purpose of this layer is to allow the passage of rain water whilst preventing by filtration, sand, soil, dirt and other elements from being washed down between the insulation joints.

Such elements could cause damage to the membrane through abrasion.

The filtration layer is normally composed of FLAG geotextile in non-woven felt, minimum weight 200 g/m².



8 - DIVIDING AND SLIPPAGE LAYER (ballasted roofs subject to pedestrian traffic)

This physically separates the protective paving from the waterproof layer in order to prevent any surface tension in the paving, due to thermal expansion or settling, from being transmitted to the remaining layers, thereby damaging it. It also prevents the thinnest part of any concrete from clogging the underlying layers.

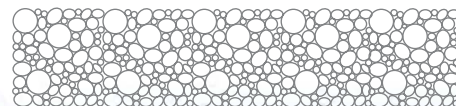
It can be made of the following materials:

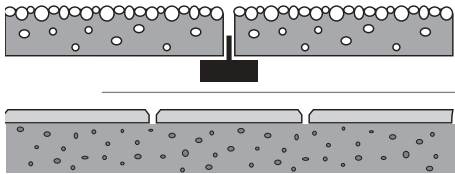
- a) Film of VAPORFLAG polyethylene, with thickness ranging from 0.30 to 0.40 mm, dry-laid with 10 cm edge overlap, and secured with double-sided adhesive tape;
- b) A layer of 0.8 to 1.0 mm FLAGON PeSL polyethylene sheet, dry-laid with 10 cm edge overlap, and secured with double-sided adhesive tape;
- c) Silicone paper (paraffin paper) dry laid with 25/30 cm edge overlap;
- d) FLAGON TS liner, loosely laid, the edges of the sheets butted together.



9 - BALLASTING LAYER (ballasted roofs not subject to pedestrian traffic)

This prevents wind from uplifting or moving the dry-laid stratification package. The ballasting layer generally consists of river-washed, round gravel, 10/30 mm, loose-laid to a minimum depth of 30/40 mm.





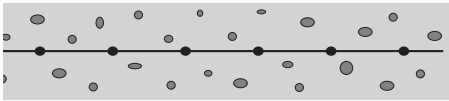
10 - BALLASTING AND PROTECTION LAYER

(ballasted roofs for pedestrian traffic)

This prevents wind from uplifting or moving the dry laid stratification package as well as affording the protection required to allow pedestrian traffic without damage to the waterproof system.

Ballasting may be effected using the following materials and laying methods:

- a) Dry-laid pre-cast slabs laid on circular polyethylene supports;
- b) Dry-laid pre-cast and/or interlocking square paving slabs on a sand bed with minimum 60 mm thickness;
- c) Traditional paving covered with tiles laid on a bed of cement mortar.

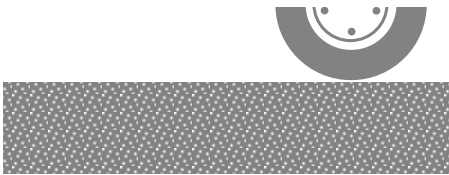


11 - RIGIDITY AND WEIGHT DISTRIBUTION LAYER

(ballasted roofs subject to vehicular traffic)

This layer accommodates any changes resulting from mechanical, physical and chemical stress caused by vehicular traffic.

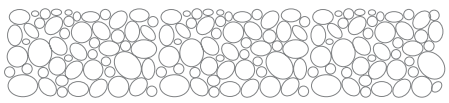
The rigidity layer is normally made from cement capping, 60 mm thick, reinforced with an electro-welded steel mesh.



12 - VEHICULAR CARRIAGEWAY LAYER

This can be effected using the following materials and laying methods:

- a) Reinforced concrete slabs cast with appropriate joints;
- b) Traditional asphalt (binder);
- c) Interlocking paving laid on rolled sand. Please refer to the laying procedures provided by the paving manufacturer.



13 - DRAINAGE LAYER (ballasted roofs for roof gardens)

The function of this layer is to ensure drainage outside the waterproof layer. It may consist principally of the following:

- a) River-washed, round gravel, 10/30 mm, laid loose to a depth of 50/60 mm;
- b) Composite draining structures, with various typologies.



14 - VEGETATION LAYER (ballasted roofs for roof gardens)

The function of this layer is to ballast the waterproofing system, while affording a pleasant architectural feature.

15 – FIXING DEVICES (mechanically fixed exposed roofs)

These prevent wind from lifting or moving the waterproofing system.

The following fixing devices may be used:

- Expansion fixing plugs and plates for concrete substrates;
- Self-tapping screws and plates for metal/timber substrates;
- Pre-drilled galvanised steel bars;
- Pressure plates for screws or plugs.

The type and number of fixings required will be determined by calculation of the size and zones of influence of wind loading upon each individual roof in accordance with applicable regulations.



16 - ADHESIVE LAYER (fully adhered exposed roofs)

This prevents wind from lifting or moving the waterproof layer.

The adhesive used is single-component polyurethane-based FLEXOCOL A 89, evenly distributed on the substrate by means of a spreader or roller.

FLAGON PVC ROOFING SYSTEMS

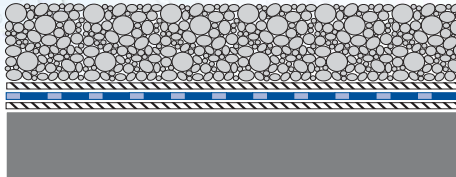
FLAGON PVC waterproof membranes can be used both for newly built roof systems and for renovating existing roofs.

FLAGON PVC membranes have been designed both for ballasted roof systems (protected) and for exposed roof systems (unprotected), according to the following definitions:

A - BALLASTED ROOF SYSTEMS (PROTECTED)

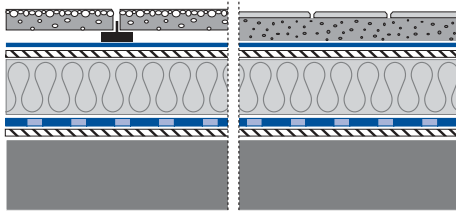
Flat or inverted roofs (with up to 5% gradient) in which the layers that form the waterproof system are dry-laid and ballasted:

- with gravel to prevent wind from lifting, moving or damaging them;
- with other materials to make them suitable for pedestrian or vehicular traffic (see detailed laying instructions).



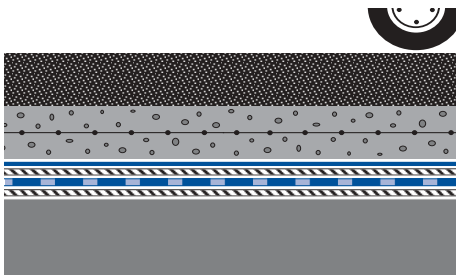
A.1 Ballasted roof system not for pedestrian traffic

Typically, these are ballasted with gravel and are intended for pedestrian transit for maintenance operations only (see structural elements and layers of roof point 9).



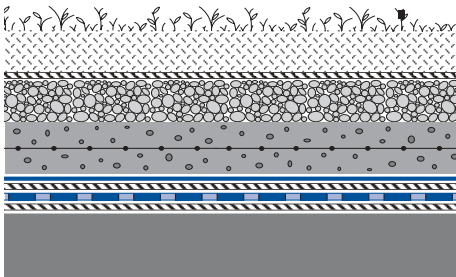
A.2 Ballasted roof system for pedestrian traffic

These are characterized by possible or frequent transit of people. Floors, decks, sidewalks, ramps, for public or private use, where the waterproofing system must be protected against damage caused by pedestrian traffic (see functional elements and layers of roof point 10).



A.3 Ballasted roof system for vehicular traffic

Roof systems and ramps, characterized by possible or frequent transit of vehicles. Car parks, garages, parking decks, floors for vehicular traffic, ramps, for public or private use, where the waterproofing system must be protected against damage caused by vehicular traffic and by contact with aggressive liquids (hydrocarbons), which may be released from the vehicles (see functional elements and layers of the roof point 11-12).



A.4 Ballasted roof system with roof garden or green roof

Ballasted roof systems made with the roof garden or green roof system. Traditionally cast floors or pre-cast floors in which the waterproofing system must be protected against root perforation, against the attack of micro-organisms living in the soil and against any accidental damage during system laying and/or maintenance phases (see functional elements and layers of the roof point 13-14).

B - EXPOSED ROOF SYSTEM (UNPROTECTED)

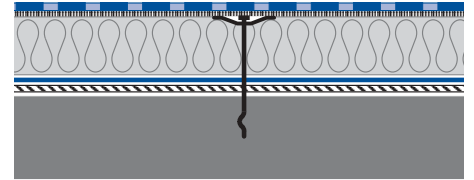
Flat or sloping roof which cannot accommodate a ballasting layer. The waterproof system should, therefore, be firmly fastened to the substrate to prevent wind from lifting or moving it. Pedestrian traffic possible for maintenance operations.

B.1 Fully adhered system

Flat or sloping roof, made of traditionally cast or pre-cast floors in concrete, metal decks with insulation boards etc., in which the waterproof system, or waterproof liner only, is glued so as to fully adhere to the substrate to prevent the wind from lifting or moving it.

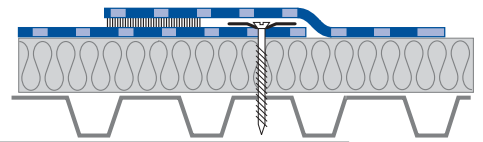
The waterproof membrane will also be weather-resistant (rain, snow, hail, UV rays, etc.) and moderately accessible to pedestrian transit for maintenance operations (see functional elements and layers of the roof point 16).

This laying method includes spreading Flexocol A89 polyurethane glue over the whole surface with a spreader or roller (see detailed laying instructions).

**B.2 Mechanically fixed roof system**

Flat or sloping roof, made of traditionally cast or pre-cast floors in concrete or with profiled metal decks, buildings, etc., in which the waterproof system is mechanically fixed to the substrate to prevent the wind from lifting or moving it. The system should be weather resistant (rain, snow, hail, UV rays, etc.) and be moderately accessible to pedestrian traffic for maintenance operations.

Two different mechanical fixings systems are possible: fixing by washers and screws or linear fixing with a bar (see detailed laying instructions).

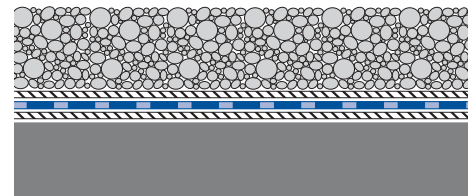
**FUNCTIONAL SOLUTIONS**

Waterproofing solutions are diverse and depend upon the problems to be solved and the performance to be achieved.

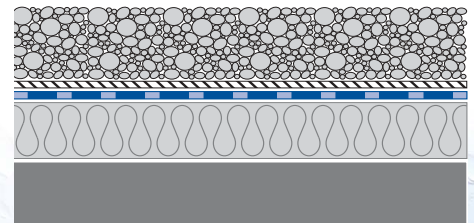
Based on the presence of an insulation element, they can be classified as follows:

A – NON-INSULATED ROOF SYSTEM (cold roof)

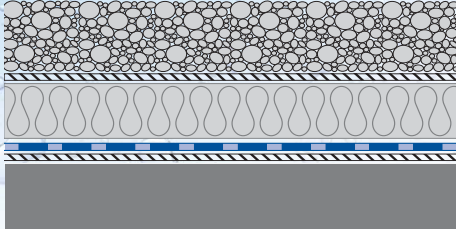
This refers to those roofs that do not require the inclusion of thermal insulation. Either ballasted or exposed roof systems can be used.

**B - INSULATED ROOF SYSTEM**

This refers to those roofs that require thermal insulation to be included in the stratification scheme below the waterproof covering (see functional elements and layers of the roof point 4). Depending on the position of the insulation element in the roof-build up we can distinguish:

**B.1 Warm roof systems (with or without vapour shield or barrier)**

Roof build-up with the insulation element placed underneath the waterproof layer. Either ballasted or exposed waterproof systems can be used.

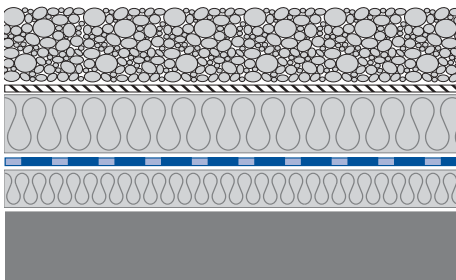


B.2 Inverted roof systems

Roof build-up with the insulation element placed above the waterproof layer. The inverted roof solution provides the following advantages compared to the warm roof solution:

- a) the waterproof layer is protected from thermal shocks and maintains an optimum and virtually constant surface temperature throughout the year. This extends the useful life of the waterproof layer;
- b) the roof build up does not need a vapour shield or barrier layer because the theoretical dew point is always above the waterproof layer;
- c) the waterproof membrane remains well protected against accidental mechanical damage, both during the laying of the ballasting layer and during maintenance operations.

Only the ballasted type of roof system can be used



B.3 Sandwich roof systems (with or without vapour shield or barrier)

This refers to those coverings that require the inclusion of thermal insulation in the roof build up specification, both above and below the waterproof layer.

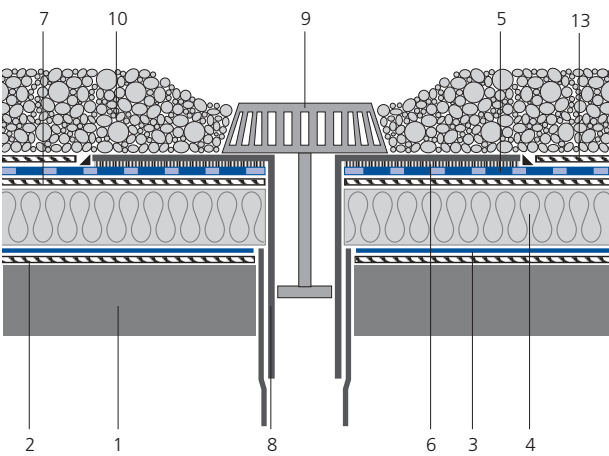
The sandwich roof system is particularly suitable when the substrate decking is not perfectly smooth and even, e.g. prefabricated roof tiles, and where it would, therefore, be ineffective to use a single adjustment layer of geo-textile.

The advantages of the sandwich roof system, as opposed to the traditional warm roof solution, are the same as those of the inverted roof.

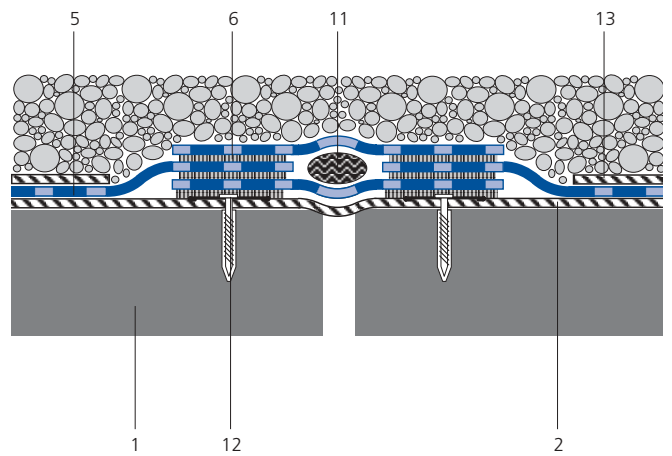
Only the ballasted type of roof system can be used.

DETAILS AND PARTICULARS

Good design of the finishing details and particulars of the waterproofing system is essential for optimal results. In the following pages we reproduce only a few examples of the many available.



RAINWATER DRAIN UNION
WARM ROOF SYSTEM WITH VAPOUR BARRIER
BALLASTED NOT FOR VEHICULAR TRAFFIC

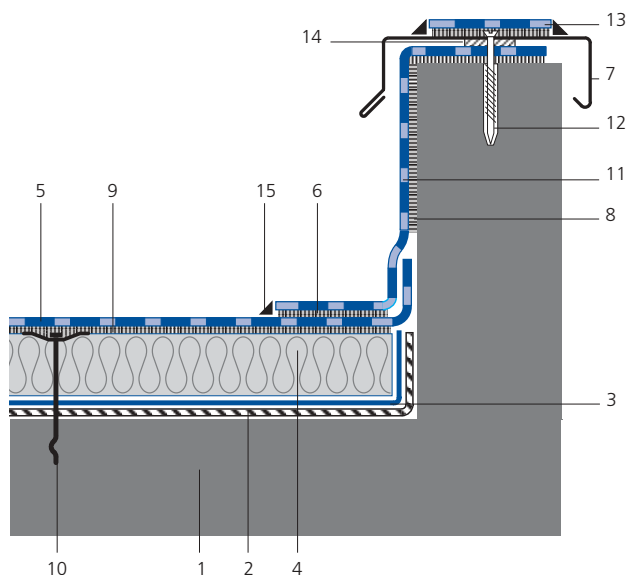


EXPANSION JOINT
NON-INSULATED ROOF SYSTEM
BALLASTED NOT FOR PEDESTRIAN TRAFFIC

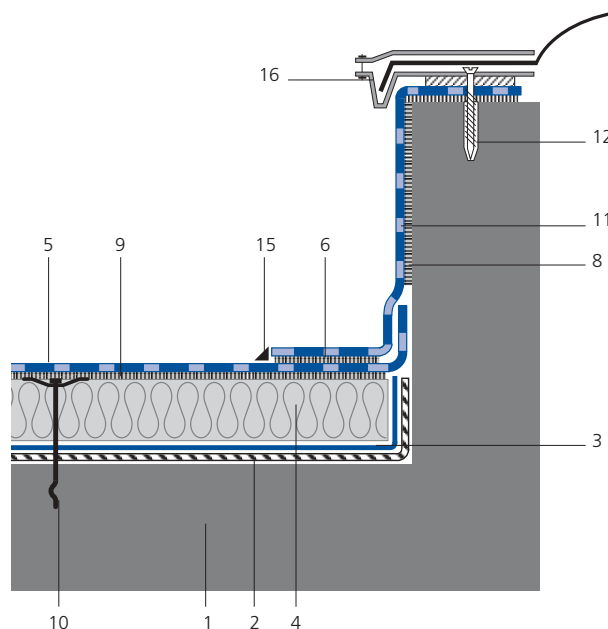
LEGEND

Layer	Function/Material	Contract specification item •
1	Supporting element	1.A
2	Adjustment layer	2.B
3	Vapor shield	3.A / 3.B
4	Thermal insulation element	5.F
5	FLAGON SV WATERPROOF LINER	7.A/7.A5
6	Manual welding	
7	Separating layer	6.B
8	PVC union	13.B
9	Gravel guard	
10	Ballasting layer	12. A
11	Compressible element in neoprene	
12	Fixing element	15.B
13	Filtering layer	9.A

• Please refer to the Contract Specification Items folder in the CD-ROM attached to the documents



ROOF-EDGE JUNCTION WITH CAP
WARM ROOF SYSTEM WITH VAPOUR BARRIER
FULLY ADHERED

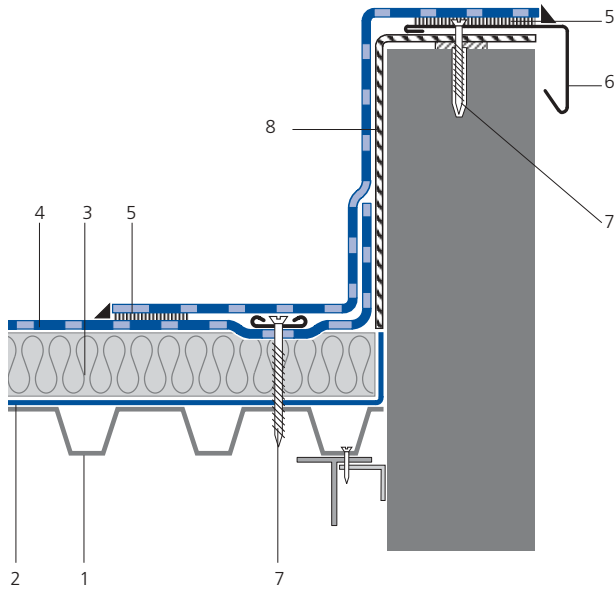


EFLOOR LIGHT JUNCTION
WARM ROOF SYSTEM WITH VAPOUR BARRIER
FULLY ADHERED

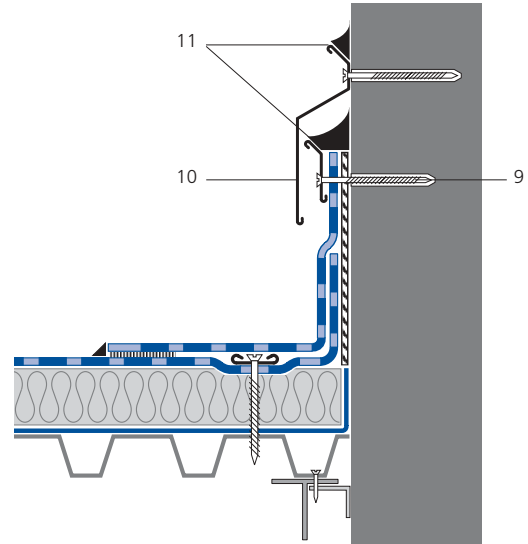
LEGEND

Layer	Function/Material	Contract specification item
1	Supporting element	1.A
2	Adjustment layer	2.B
3	Vapor shield	3.A / 3.B
4	Thermal insulation element	5.F
5	FLAGON SFC WATERPROOF LINER	7.C1/7.C5
6	Manual welding	
7	Finishing element	15.D
8	FLEXOCOL V vertical gluing layer	15.Q
9	FLEXOCOL A89 gluing layer	15.E
10	Fixing element	15.R
11	FLAGON SV WATERPROOF LINER	7.A1/7.A5
12	Fixing element	
13	FLAGON SV WATERPROOF LINER	7.A1/7.A5
14	Wind seal	16.H
15	Flagon paste	
16	Sky light	

• Please refer to the Contract Specification Items folder in the CD-ROM attached to the documents



ROOF-EDGE JUNCTION WITH FLASHING
WARM ROOF SYSTEM WITH VAPOUR BARRIER
MECHANICALLY FASTENED

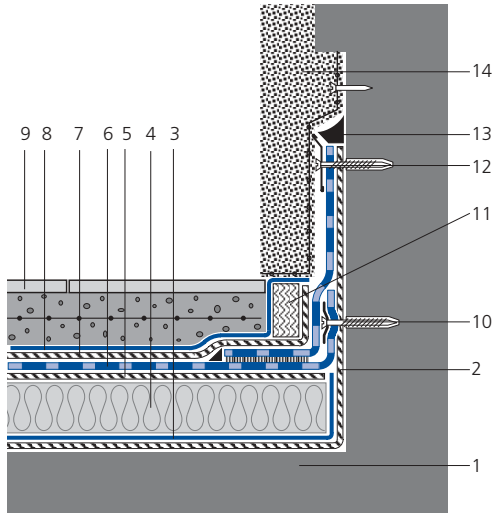


WALL JUNCTION WITH COUNTER-PROFILE
WARM ROOF SYSTEM WITH VAPOUR BARRIER
MECHANICALLY FASTENED

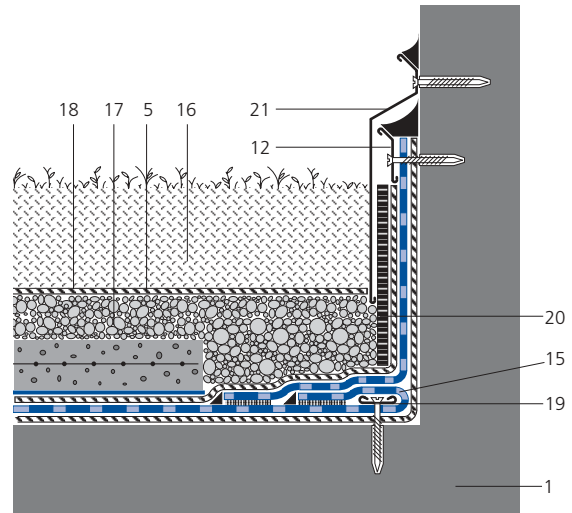
LEGEND

Layer	Function/Material	Contract specification item
1	Supporting element	1.C
2	Vapor shield	3.A / 3.B
3	Thermal insulation element	5.F
4	FLAGON SRF or SR* WATERPROOF LINER	7.G2/7.G4 -7.H2/7H.4
5	Manual welding	
6	Finishing element	15.D
7	Fixing element	15.M
8	Adjustment layer	2.A / 2.B
9	Fixing element	15.C
10	Finishing counter-profile	
11	Sealing	

* The type of liner to be used depends on the chemical compatibility with the thermal insulation element selected
 • Please refer to the Contract Specification Items folder in the CD-ROM attached to the documents



WALL JUNCTION PROTECTED BY PLASTER
WARM ROOF SYSTEM WITH VAPOUR BARRIER
BALLASTED FOR PEDESTRIAN TRAFFIC



WALL JUNCTION NON-INSULATED ROOF SYSTEM
BALLASTED WITH ROOF GARDEN OR GREEN ROOF

LEGEND

Layer	Function/Material	Contract specification item
1	Supporting element	1.A
2	Adjustment layer	2.B
3	Vapor shield	3.A / 3.B
4	Thermal insulation element	5.E
5	Separating layer	6.C
6.6	FLAGON Sp WATERPROOF LINER	7.B1-7B5
7	Separating layer	6.C
8	Anti-soaking layer	10.D
9	Finishing and ballasting layer	12.C
10	Fixing element	
11	Compressible element	
12	Fixing element	15.G
13	Sealing	
14	Finishing element with plaster mesh	
15	FLAGON BT WATERPROOF LINER	7.F1-7F3
16	Vegetable soil layer	
17	Draining layer	
18	Filtering layer	9.A
19	Fixing element	15.A
20	Vertical protection element	
21	Finishing element	

• Please refer to the Contract Specification Items folder in the CD-ROM attached to the documents

HOW TO CREATE CONTRACT SPECIFICATIONS

To draw up detailed, customized specifications, proceed as follows::

a) Log on to www.flag.it or use the Flag CD-ROM attached to the documentation.
a.1) enter the RPA (Roof Project Assistant) section to use the "dynamic database query system", a navigation path that determines the solution that best suits your project.

Now, by choosing the "specifications" option, you can view the selected stratification package, which has an interactive legend, notes and list of the complete specification items (the solution can be exported to your computer and can be modified and printed).

You can also download the selected sectional drawing in AUTOCAD format, customise it and incorporate it into the design drawings.

By selecting the "details" option, you can view the construction details and finishings relating to the various waterproofing solutions.

a.2) if the design solution has already been defined, it can be promptly selected in the "application fields" section by entering "PVC liners" and then choosing the "specifications" option to view the selected sectional package and following the same procedure described above.

b) Use the Flag CD-ROM attached to the documentation, opening the specification items folder and selecting, item by item, those relating to the design solution.

Note: All contract specification items are identified both by a name and by an alphanumeric code (e.g. 7.G2).

c) Contact the Flag S.p.A. offices (phone +39.035.4940949 fax +39.035.4940649) or send an e-mail to: info@flag.it to obtain further detailed information concerning the characteristics of the items relevant to your application.





GENERAL LAYING INSTRUCTIONS

1. STORAGE

FLAGON PVC membranes are delivered on site in rolls, on flat, ventilated pallets. They should be stored in a dry place or, if this is not possible, they should be protected against dampness, rain and snow using waterproof sheets.

2. WELDING THE SHEETS

Three welding systems may be used:

- manual hot air guns
- automatic equipment
- THF tetrahydrofurane solvent

These welding systems are not mutually exclusive but can be used together according to the specific requirements and characteristics of each waterproofing project.

Regardless of the welding system used, sheet overlaps must be absolutely clean and dry.

2.a Hot air manual welding

a) Direct welding system

The layers must be overlapped by 5 cm and fixed by welding spots every 15/20 cm (spot welding). The welding temperature varies according to the layer thickness, the environmental temperature and the nozzle used. Depending on the environmental conditions on the building site, the welding temperature with a 40 mm nozzle is around 550°C (+/-10°C). With a 20 mm nozzle, the welding temperature ranges from 470° and 500°C.

b) Pre-welding system

The layers must be overlapped by 8 cm and fixed by welding spots every 40 cm (spot welding). The next phase is the pre-weld, carried out parallel to, and behind, the main welding line. The pre-weld should be tested for delamination before the main weld is carried out.

The welding temperature should be approximately 450°C depending on the environmental conditions on the building site.

2.b Welding using automatic equipment

Automatic welding can be carried out with hot air welders.

The hot air creates the weld for each single fixing line, at a temperature of approx. 500/530°C, depending on the external temperature and thickness of material, at a speed of 170/200 cm/min.

Before installing the waterproofing system, it is advisable to make a sample test weld followed by a delamination tests (destructive test).

2.c Welding using chemical (THF) solvents

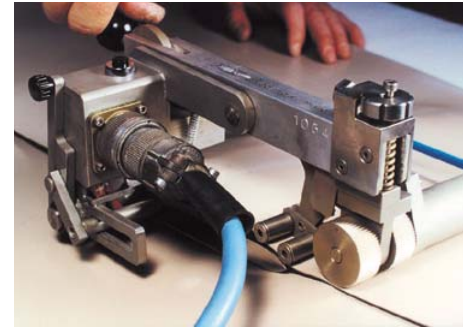
Solvent welding using tetrahydrofuran (THF) is carried out using a brush connected to a solvent dispenser between the sheets to be welded.

The membranes to be welded must overlap by 5 cm.

Welding is carried out by sliding the solvent-fed brush between the sheet edges and applying steady pressure by means of a suitable roller at a distance of approximately 2 - 3 cm from the brush applicator.

Welds must be checked by running the point of a seam probe along the weld line at least 12/24 hours after solvent welding.

The weld is then sealed by applying a bead of Flagon Pasta.



3. USE OF ACCESSORIES

To ensure perfect compatibility, use only prefabricated corners, fittings and unions of the Flagon PVC range, which are made of the same compound as the waterproof liner. Use a manual hot air gun to weld these to the FLAGON PVC waterproof liner.

4. FLAGMETAL LAMINATE

FLAGON sheet metal laminated sections are easily fixed using expansion plugs (at least 3 per linear metre) and allow the covering to be directly welded to the section. In the case of flashings or cappings, expansion gaps should always be provided at joints to avoid the covering from tearing due to linear expansion of the sections.

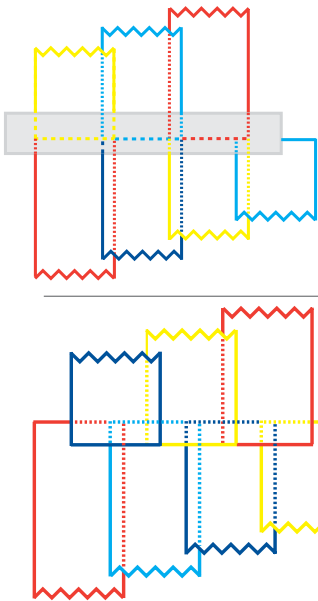
5. SHEET ENDS

All sharp corners at the ends of single sheets must be rounded using cutters or scissors.

It is strongly recommended that the number of membrane layers be limited to a maximum of three.

To achieve this effect one of the following arrangements should be adopted:

- lay a transverse sheet or strip (minimum width 20 cm) across the bottom of two or more perfectly aligned and parallel sheets to provide a connection to the subsequent set;
- offset each set of sheets transversally.



CHECKS

CHECKING LAID SURFACES (signalling effect)

The contrasting colours of the upper and lower surfaces of most FLAGON PVC membranes allows the integrity of laid membranes to be easily checked. If, during installation, the waterproof membrane has been in any way damaged or abraded, this will be readily apparent, as the darker inner layer of the membrane will be exposed. This can then be easily remedied by welding a piece of the same material over the damaged area.

CHECKING OF THE MANUAL, AUTOMATIC AND THF WELDING

Integrity of welding can be checked by mechanical, pneumatic or destructive testing.

a) Mechanical test (weld made by manual hot air gun, automatic equipment or THF solvent)

This is carried out by passing the rounded tip of a seam probe along the welding line, exerting an adequate pressure to identify any defect in the welded seam.

This operation is absolutely necessary to check the integrity of the welding and should be performed when the material is cold (or, after 12/24 hours, with THF). Defective areas should be re-welded or overlaid with a compatible cover strip membrane. After checking the THF welded seams a liquid PVC paste must be applied along the length of each welded seam.

b) Pneumatic test (weld made by automatic equipment, i.e. Saldamax Mille)

This method ensures an absolutely objective check of the welding seams.

With special calipers, seal the ends of the welding seams to be tested. Insert a needle connected to a pressure gauge into the groove between the two welding seams made by Saldamax Mille. Introduce pressurised air by means of a foot pump at approximately 2 bar. Wait 1 minute to ensure the complete expansion of the inside groove and then start the actual test taking the pressure back to 2 bar. After a 10 minute interval, again check the air pressure. A 20% pressure decrease (due to the membrane itself expanding) is acceptable.

Where FLAGON transparent liners have been used, the pneumatic test can be carried out also by contrasting liquid under pressure. Any imperfectly welded spots are shown by the appearance of colour stains.

This pneumatic test guarantees the integrity of the welding seams.

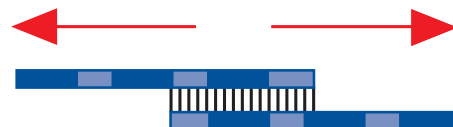
**c) Destructive testing (hot air welded seams)**

A destructive tensile test is carried out by peel testing a sample of the weld.

To do this, take out a 1 cm wide section of the previously welded seam.

Under test, the weld should not separate, nor should the covering tear.

Note: The test, although manually performed on site, is based on the provisions set forth by the UEAtc Directive.

**DETAILED LAYING INSTRUCTIONS****1) BALLASTED ROOF SYSTEM**

The waterproof layers used for a ballasted roof system are laid independently of the substrate. Ensuring adequate overlaps, place the dry, waterproof layers in succession. If homogeneous membranes are laid (ballasting for vehicular traffic or roof garden), fix the waterproof sheets along the roof perimeter using a pre-drilled bar. This perimeter fixing is made using the FLAGON pre-drilled bar, in galvanised steel with 20/10 thickness.

The positioning of the fixing bar, horizontally or vertically, at the foot of the brickwork, is related to the existence and thickness of the insulation element, as well as to the nature of the substrate (e.g. it cannot be made horizontally in the presence of light concrete piers).

Once the installation of horizontal sheets is complete, the vertical upstand and the details are carried out according to the instructions provided in "construction details and particulars" on the website www.flag.it and on the Flag CD-Rom.

2) FULLY ADHERED ROOFING SYSTEM (glued):

This laying method involves spreading Flexocol A89 single-component polyurethane glue over the whole gluing surface using a spreader or roller.

In these circumstances, FLAGON PVC membranes are combined with a thermally treated geotextile, which performs two basic functions: it improves adhesion and distributes the stress and movements caused by the insulation element or by the structure. If the substrate is particularly dry, you need to moisten it by spraying water on the surface to be glued.

Methods of laying differ according to the type of substrate on which the waterproof membrane is to be installed.

Examples are as follows:

2.1 Non-insulated roof

Carry out a precautionary check ensuring the surface is clear, dry and as smooth as possible. The surface should provide adequate support for the roofing system.

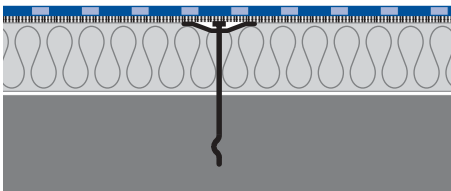


The waterproof liner is glued directly to the substrate by means of Flexocol A89 polyurethane glue. The amount of glue to be used is approx. 300/350 gr/m² (depending on the porosity of the substrate) and is spread over the substrate using a spreader or roller.

Lay the waterproofing membranes, allowing an adequate side overlap for welding. Once the laying of the sheets on the horizontal plane is complete, execute the vertical upstand and details according to the instructions provided under "construction details and particulars" on www.flag.it and on the Flag CD-Rom.

2.2 Roof with insulation boards

The insulation boards should be mechanically fastened (in compliance with the manufacturer's instructions) to the supporting surface by means of fixing screws and washers.



Fleece-backed FLAGON waterproofing membrane is then glued onto the insulation panels by means of Flexocol A89 polyurethane glue.

The amount of glue to be used depends upon the type of board used ranging from 300/400 gr/m² and is spread over the substrate using a spreader or roller. Proceed as described above at point 2.1.

2.3 Re-roof with bituminous layer

In this case, the existing bitumin has failed. In the case of an existing felt system with a mineral slate surface finish, the surfaces must be thoroughly cleaned before laying the new FLAGON PVC waterproof liner.

Proceed as described in the above paragraphs.



3) EXPOSED ROOF (mechanically fixed)

Preliminary note:

In the case of a substrate made of profiled metal sheet the waterproof sheets should be fixed at right angles to the longitudinal rib of the metal profile. With a concrete substrate, the waterproof sheets can be laid both perpendicularly and transversally.

The basic criteria for the fixing design are: nature of support, shape of the roof, building height, wind speed of the area, topography of the area.

Wind loadings affect all roof surfaces. The design criteria to overcome these factors relates to three areas; perimeter, corners and field zones.

The distance between each single fixing and the number per m² for each area are established during the design phase of each project.

The section of membrane that is placed along the roof perimeter zone is most exposed to wind so you always need to include an extra fixing line with a pre-drilled bar in galvanised steel at the foot of the perimeter upstand.

The corner zone is the most heavily affected by the wind and obviously requires the largest number of fixing points. For more information and detailed calculations, please contact our Technical Offices.

Mechanical fixing can be carried out by two different systems:

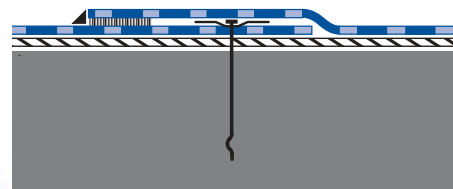
3.1 Side lap fixing system

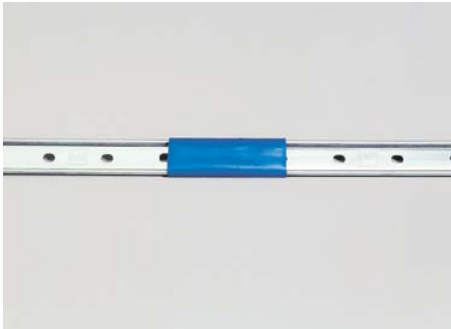
Using this system the reinforced waterproofing membrane is fixed through the deck/substrate by appropriate fixings and distribution plates.

The membrane is fixed along its outside edge at centres determined by the wind load restrictions.

Where additional fixings are required to the perimeter and corner zones a further row of fixings can be installed along the centre of the membrane and then overlaid with a welded strip of membrane.

The same fixing method may be applied to a pre-drilled bar system in place of fixings and pressure plates.



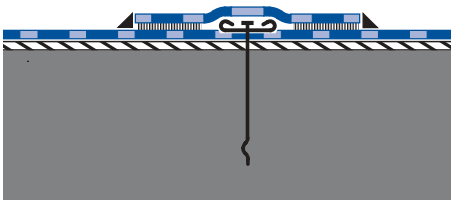


3.2 Bar fixing

This system is used if the type of supporting element requires the positioning of the fastening line at a pre-established centre distance, owing to defects visible underneath the roofing.

The fastening lines are placed parallel to the lengthwise axis of the line. Instead of distribution plates, a pre-drilled bar in galvanised sheet iron is used for all the fastening lines, not only for those at the foot of the vertical elements.

To protect the integrity of the waterproof membrane in case of damage caused by pedestrian traffic or continuous pressure caused by overloads, with this fastening system, you always need to insert the FLAG ANTI-PUNCTURING JOINT at the junction between two adjacent bars.



This system enables the contractor to lay the waterproofing membranes on the roof and weld them together using a 5 cm standard overlap.

Once in position the bars are fixed at pre-determined centres, using appropriate screws, securing the membrane in place.

Once in place the bars are overlaid with a welded strip of membrane.

The design must provide adequate drainage between the fixing lines to allow free flow of rainwater to down-pipes and channels.

In order to prevent wind moving or damaging the membrane during the installation this operation must be carried out during the laying of the membrane.

Provide adequate drains between the fixing lines to allow the outflow of rainwater to down pipes and channels.

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